

jω Electronics

MTP Series Application Note AN0001: Electronic Register Switching for Pipe Organs

Introduction

In medium to large sized pipe organs, it is common to have more than one pipe per musical note, creating a number of ranks of pipes or 'registers' which can be enabled as required by the music to build up a particular overall tone. It is possible to arrange for registers to be selected using mechanical or pneumatic means, but such methods will generally increase the constructional complexity of the organ windchests and can be difficult to control automatically from the music in the case of mechanical player organs.

This application note describes a way in which an MTP-series MIDI-to-parallel converter from ***jω Electronics*** can control a multiple-register organ with a mechanically simple arrangement and some additional electronic components.

Organ Constructional Requirements

For electronic register switching to be used, it is necessary for each pipe to have its own solenoid which controls the air to it. With this arrangement, any pipe can be mounted at any position on the main wind supply without sliders, vents or other mechanical devices being required, simplifying the windchest layout. All solenoids controlling the pipes within one register share a common connection, there being separate commons for each register.

Circuit Detail

Figure 1 gives the schematic diagram of an example installation having three registers with the wiring for three notes shown. Other notes may be added in a similar manner up to the output number limit of the MTP circuit.

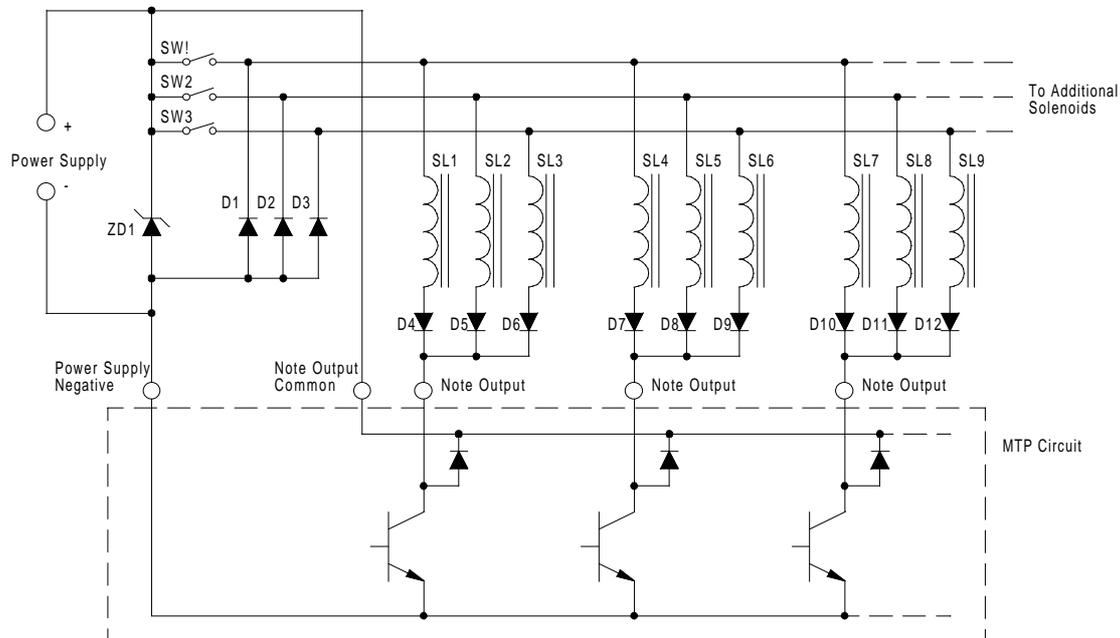


Figure 1: Example circuit showing three registers

Referring to Figure 1, each MTP circuit output controls all the solenoids associated with that note. Solenoids SL1, SL2 and SL3, for example, will be for pipes which sound the same musical note, but each of these solenoids relates to a different register. Diodes D4 to D12 prevent reverse current flow back to the commons of any inactive registers which could otherwise cause unwanted notes to sound. Any further solenoids added to the system must also have series diodes in the same way.

The registers are selected by switches SW1 to SW3, where closing the switch enables that register to play and opening it silences the register. D1 to D3 provide a safe freewheel path for inductive current in the event that a register is switched off whilst any MTP note outputs remain on. Zener diode ZD1 can dissipate stored inductive energy from the solenoids if a note output and register are switched off simultaneously, since there would be no freewheel current path in this case. In practice, it is likely that the power supply will contain a smoothing capacitor which will absorb the energy in this situation, but having ZD1 in circuit ensures that the MTP driver supply voltage will not be exceeded if the power supply capacitance is small.

Whilst SW1 to SW3 are shown as simple switches, these could just as easily be the normally-open contacts of small relays. By driving the relay coils with spare MTP outputs, the registers can be enabled and disabled entirely through MIDI control which is ideal for mechanical music applications. If register relays are to be driven by the same MTP circuit as controls the pipes, then the relay coils must be powered directly from the power supply and not from any of the switched solenoid commons. It is not necessary to include diodes in series with the relay coils.

Component Selection

The choice of component values for the register circuit depends largely on the currents and voltages to be switched. Firstly, it is important to note that in this configuration, each MTP output has more than one solenoid connected to it. Unless some means is taken to limit the number of registers that can be enabled at a time, the solenoids must be chosen so that the MTP circuit's output current ratings (see relevant MTP installation note) are not exceeded when all registers are selected simultaneously.

The solenoid series diodes (D4 to D12 in Figure 1) must have a reverse voltage rating of at least the maximum supply voltage and a forward current rating of at least the current drawn by one solenoid at full supply voltage. For the MTP-1, MTP-3 and MTP-6 circuits, the maximum permissible solenoid current is 500 mA, so a diode with 1 A rating would be suitable.

Switches SW1 to SW3 and diodes D1 to D3 must have a reverse voltage rating of at least the maximum supply voltage and a forward current rating of at least the sum of the currents drawn by as many solenoids as will be turned on at any one time. Since this figure is dependent on the music being played, it is safest to rate these devices at a value of at least the current drawn by one solenoid multiplied by the total number of playable notes. In the case of the diodes which are only required to conduct current for short time intervals when a note is switched off, it is generally acceptable to select a device based on its peak rather than continuous current rating.

ZD1 must have a breakdown voltage greater than the maximum that the supply voltage can be during normal operation, but less than the maximum voltage rating of the MTP circuit's output drivers. For the MTP-1, MTP-3 and MTP-6 circuits, a zener voltage of around 36 V is appropriate, with a recommended supply voltage of no more than 28 V. The current rating of ZD1 should be equivalent to those of D1 to D3, based on the assumption that the situation of de-activating all registers at the same time as turning off all notes is unlikely. As with D1 to D3, ZD1 can be selected on the basis of its pulse current rating, which is typically 20 to 30 times the continuous rating.

Important Information

This application note is supplied with the intention of providing information for system builders using the MTP series of MIDI-to-parallel converters where the user has a sound knowledge of electronics principles. Whilst this information is believed to be accurate, it is supplied without any warranty, either express or implied. ***jω Electronics*** will take no responsibility for any accident or damage to personnel or property resulting from the information given herein.

Written by: Dr J D Wale
Issue 1, 15th July 2004

www.j-omega.co.uk